

**What is claimed is:**

1           1. A seek-servo apparatus of a hard disk drive capable of moving a head to a desired track  
2           location, the seek-servo apparatus comprising an actuator which moves the head to the desired track  
3           location in response to an acceleration command having a target acceleration which leads a target  
4           velocity and a target position by a predetermined time.

5           2. The seek-servo apparatus of claim 1, wherein the predetermined time includes the time  
6           that it takes to compute the acceleration command and the time that it takes for the actuator to vary  
7           a torque of the head in response to the computed acceleration command.

8           3. The seek-servo apparatus of claim 1 further comprising:  
9           an adding/subtracting unit which subtracts a feedforward acceleration of the head from a  
10          result of adding a velocity correction value to the target acceleration, and which outputs a result of  
11          subtraction as the acceleration command; and  
12          an estimator which estimates the feedforward acceleration of the head based on the

13          acceleration command and position information concerning a position of the head moved;  
14          wherein the actuator outputs the position information to the estimator.

15          4. The seek-servo apparatus of claim 3, wherein the velocity correction value is obtained by

2 adding a position correction value to the target velocity, subtracting an estimated actual velocity of  
3 the head from a result of adding the position correction value to the target velocity, and  
4 proportionally integrating a result of subtracting the estimated actual velocity of the head from a  
5 result of adding the position correction value to the target velocity; and

6 wherein a position correction value is obtained by subtracting an estimated actual position  
7 of the head from the target position and proportionally integrating a result of subtracting the  
8 estimated actual position of the head from the target position; and

9 wherein the estimator estimates an actual velocity and an actual position based on an  
10 acceleration command output from the adding/subtracting unit and a position information output  
11 from the actuator.

12 5. The seek-servo apparatus of claim 4, wherein the actuator comprises:

2 a delayer which delays an acceleration command output from the adding/subtracting unit for  
3 the predetermined time and outputs a result of delaying the acceleration command;

4 a first integrator which integrates the result of delaying the acceleration command and  
5 outputs a result of integration; and

6 a second integrator which integrates the result of integration and then outputs an integrator  
7 result as the position information to the estimator.

1 6. The seek-servo apparatus of claim 3, wherein the actuator comprises:

a delayer which delays an acceleration command output from the adding/subtracting unit for the predetermined time and outputs a result of delaying the acceleration command;

a first integrator which integrates the result of delaying the acceleration command and outputs a result of integration; and

a second integrator which integrates the result of integration and outputs an integrator result as the position information to the estimator.

7. The seek-servo apparatus of claim 6, wherein the target acceleration is derived by the equation

$$a_w(n+1) = \frac{2\pi X_{SK}}{N_{SK}^2 T_{SM}^2} \sin \frac{2\pi(n+1)}{N_{SK}}$$

where  $a_w(n+1)$  represents the target acceleration,  $n$  represents a servo sample number,  $X_{SK}$  represents a seek length, and  $N_{SK}$  represents a seek time per a sample; and

wherein the target velocity is derived by the equation

$$v_w(n) = \frac{X_{SK}}{N_{SK} T_{SM}} \left[ 1 - \cos\left(\frac{2\pi n}{N_{SK}}\right) \right]$$

where  $v_w(n)$  represents the target velocity and  $T_{SM}$  represents a servo sampling time; and

wherein the target position is derived by the equation

$$y_w(n) = \frac{X_{SK}}{N_{SK}} n - \frac{X_{SK}}{2\pi} \sin \frac{2\pi n}{N_{SK}}$$

where  $y_w(n)$  represents the target position.

8. The seek-servo apparatus of claim 5, wherein the target acceleration is derived by the equation

$$a_w(n+1) = \frac{2\pi X_{SK}}{N_{SK}^2 T_{SM}^2} \sin \frac{2\pi(n+1)}{N_{SK}}$$

where  $a_w(n+1)$  represents the target acceleration,  $n$  represents a servo sample number,  $X_{SK}$  represents a seek length, and  $N_{SK}$  represents a seek time per a sample; and

wherein the target velocity is derived by the equation

$$v_w(n) = \frac{X_{SK}}{N_{SK} T_{SM}} \left[ 1 - \cos \left( \frac{2\pi n}{N_{SK}} \right) \right]$$

where  $v_w(n)$  represents the target velocity and  $T_{SM}$  represents a servo sampling time; and

wherein the target position is derived by the equation

$$y_w(n) = \frac{X_{SK}}{N_{SK}} n - \frac{X_{SK}}{2\pi} \sin \frac{2\pi n}{N_{SK}}$$

where  $y_w(n)$  represents the target position.

9. The seek-servo apparatus of claim 2, wherein the predetermined time is equivalent to a unit servo sample.

10. The seek-servo apparatus of claim 1, wherein the actuator comprises:  
a delayer which delays an acceleration command output from the adding/subtracting unit for the predetermined time and outputs a result of delaying the acceleration command;  
a first integrator which integrates the result of delaying the acceleration command and outputs a result of integration; and  
a second integrator which integrates the result of integration and then outputs an integrator result as the position information to the estimator.

11. The seek-servo apparatus of claim 1, wherein the target acceleration is derived by the

2 equation

$$a_w(n+1) = \frac{2\pi X_{SK}}{N_{SK}^2 T_{SM}^2} \sin \frac{2\pi(n+1)}{N_{SK}}$$

3 where  $a_w(n+1)$  represents the target acceleration,  $n$  represents a servo sample number,  $X_{SK}$  represents  
4 a seek length, and  $N_{SK}$  represents a seek time per a sample.

1 12. The seek-servo apparatus of claim 1, wherein the target velocity is derived by the  
2 equation

$$v_w(n) = \frac{X_{SK}}{N_{SK} T_{SM}} [1 - \cos(\frac{2\pi n}{N_{SK}})]$$

3 where  $v_w(n)$  represents the target velocity and  $T_{SM}$  represents a servo sampling time.

1 13. The seek-servo apparatus of claim 1, wherein the target position is derived by the  
2 equation

$$y_w(n) = \frac{X_{SK}}{N_{SK}} n - \frac{X_{SK}}{2\pi} \sin \frac{2\pi n}{N_{SK}}$$

3 where  $y_w(n)$  represents the target position.

1           14. A seek-servo method, comprising the steps of:  
2           providing a head in a hard disk drive, and  
3           moving the head to a desired track location using an acceleration command having a target  
4           acceleration which leads a target velocity and a target position by a predetermined time.

1           15. The method of claim 14, wherein the predetermined time includes the time that it  
2           takes to compute the acceleration command and the time that it takes to vary the torque of the head  
3           in response to the computed acceleration command.

1           16. The method of claim 14, wherein the acceleration command is obtained by  
2           subtracting a feedforward acceleration of the head from a result of adding a velocity correction value  
3           to the target acceleration, and wherein the feedforward acceleration of the head is estimated based  
4           on the acceleration command and position information concerning a position of the head moved.

1           17. The method of claim 16, wherein the velocity correction value is obtained by adding a  
2           position correction value to the target velocity, subtracting an estimated actual velocity of the head  
3           from a result of adding the position correction value to the target velocity, and proportionally  
4           integrating a result of subtracting the estimated actual velocity of the head from a result of adding  
5           the position correction value to the target velocity; and

wherein a position correction value is obtained by subtracting an estimated actual position of the head from the target position and proportionally integrating a result of subtracting the estimated actual position of the head from the target position; and

wherein an actual velocity and an actual position are estimated based on an acceleration command output and a position information output.

18. The method of claim 14, wherein the target acceleration is derived by the equation

$$a_w(n+1) = \frac{2\pi X_{SK}}{N_{SK}^2 T_{SM}^2} \sin \frac{2\pi(n+1)}{N_{SK}}$$

where  $a_w(n+1)$  represents the target acceleration,  $n$  represents a servo sample number,  $X_{SK}$  represents a seek length, and  $N_{SK}$  represents a seek time per a sample.

19. The method of claim 14, wherein the target velocity is derived by the equation

$$v_w(n) = \frac{X_{SK}}{N_{SK} T_{SM}} \left[ 1 - \cos\left(\frac{2\pi n}{N_{SK}}\right) \right]$$

where  $v_w(n)$  represents the target velocity and  $T_{SM}$  represents a servo sampling time.

20. The method of claim 14, wherein the target position is derived by the equation



$$y_w(n) = \frac{X_{SK}}{N_{SK}}n - \frac{X_{SK}}{2\pi} \sin \frac{2\pi n}{N_{SK}}$$

2 where  $y_w(n)$  represents the target position.

continued on next page